WaterMan – 1st method & tool workshop

Water reuse with focus on risk & life cycle assessment

08.06.2023

Interreg Baltic Sea Region

Co-funded by the European Union

SUSTAINABLE WATERS WaterMan

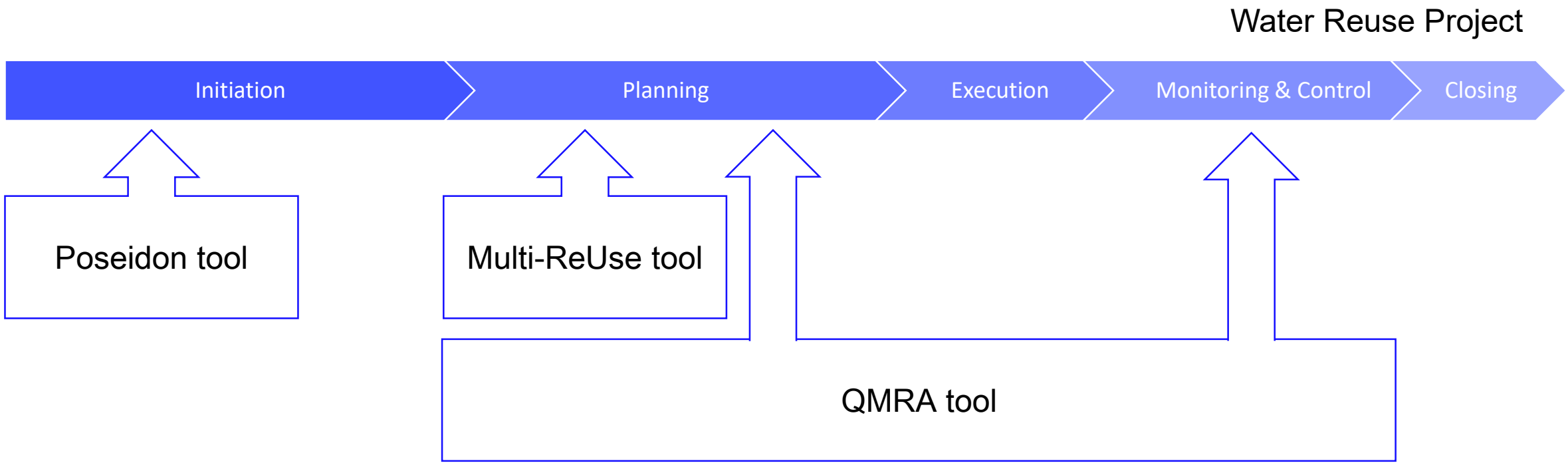
Tools for water reuse projects - Overview

Workshop in Schweinfurt June `23

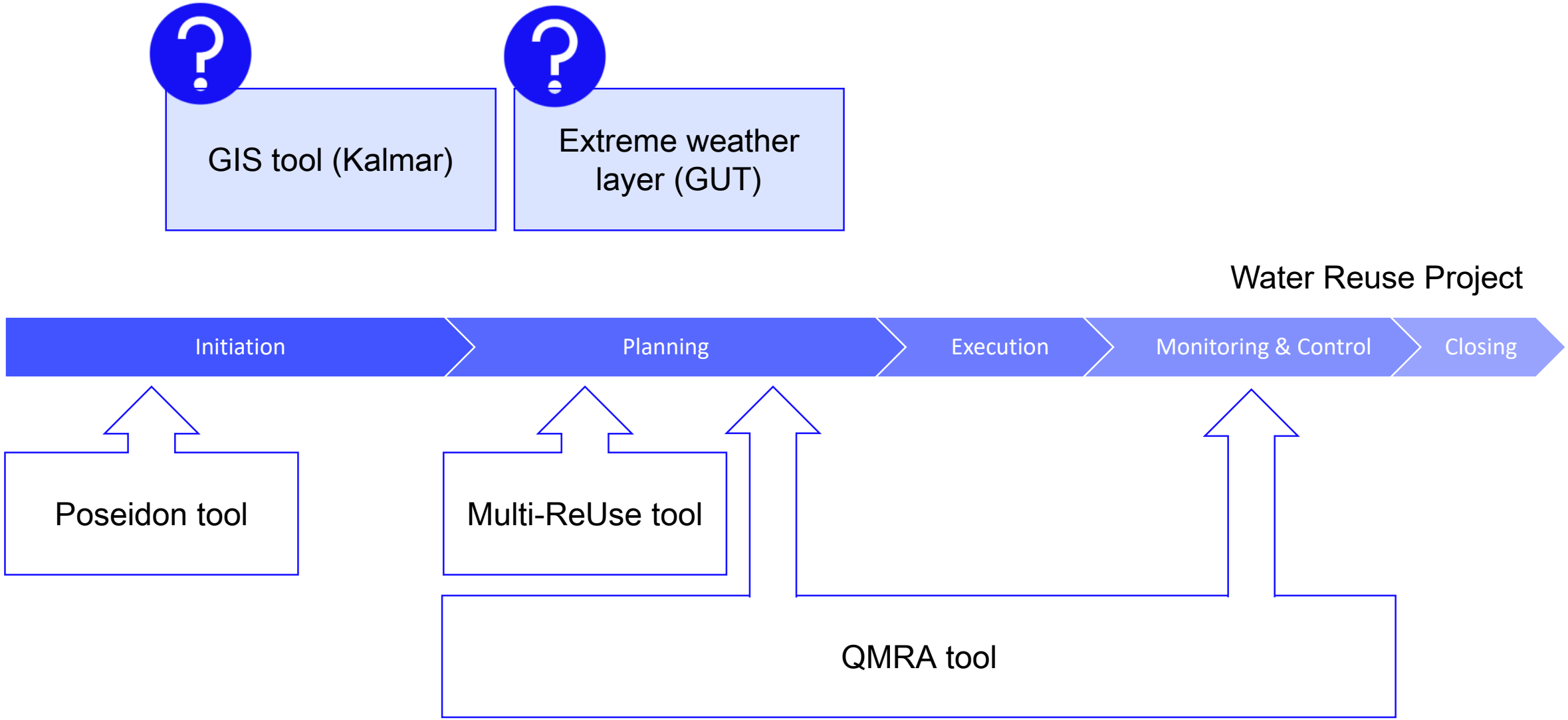
Tools from partners in the consortium	External freely available tool	Further freely available tools
• Extreme weather layer tool by GUT • Location for water retention GIS tool by Kalmar • Quantative microbial risk assessment (QMRA) tool by KWB • (Quantative chemical risk assessment tool by KWB)	• Poseidon (decision support tool for water reuse) • Multi-ReUse tool (sustainability assessment tool)	• Diagnostic Water Governance Tool • Direct potable reuse - QMRA tool (DPRisk) • QMRA by Inowas **No significant relevance for WaterMan or not fully functional**

1

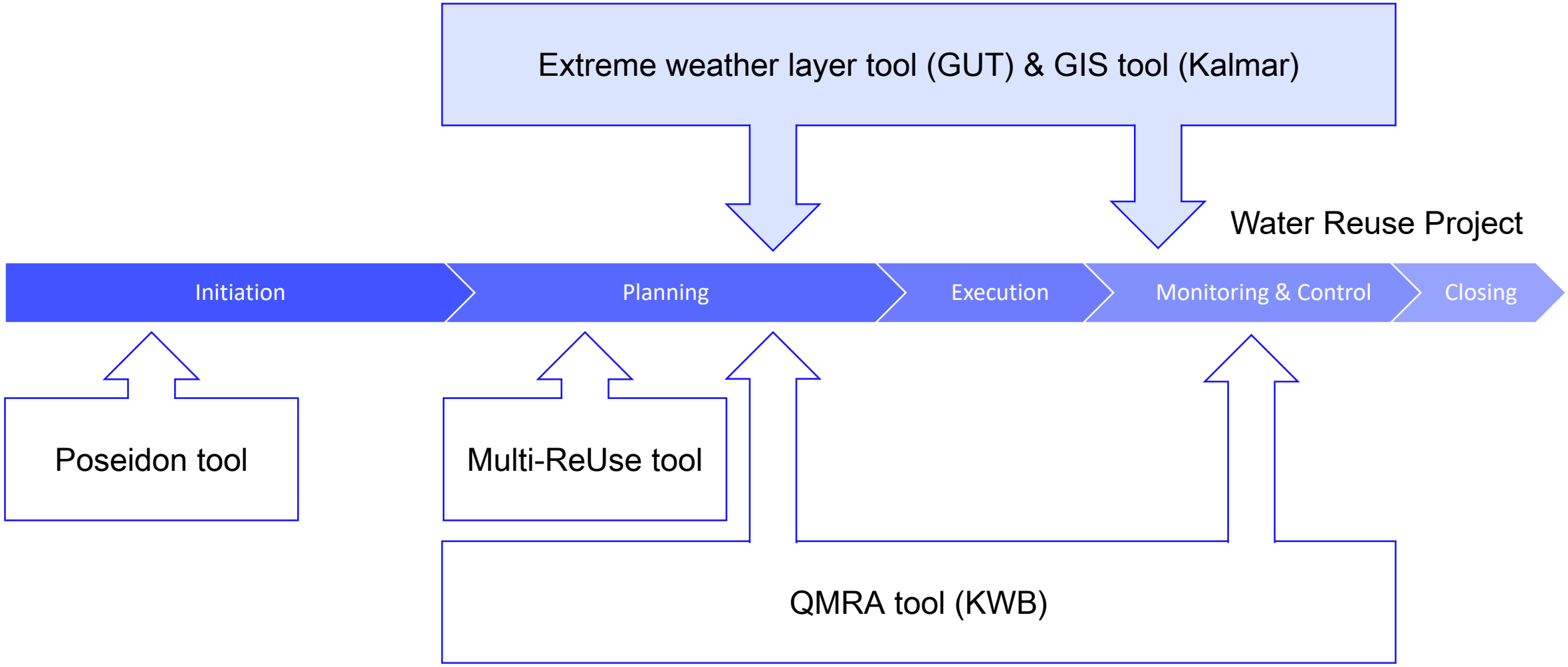
Tools for water reuse – project phase



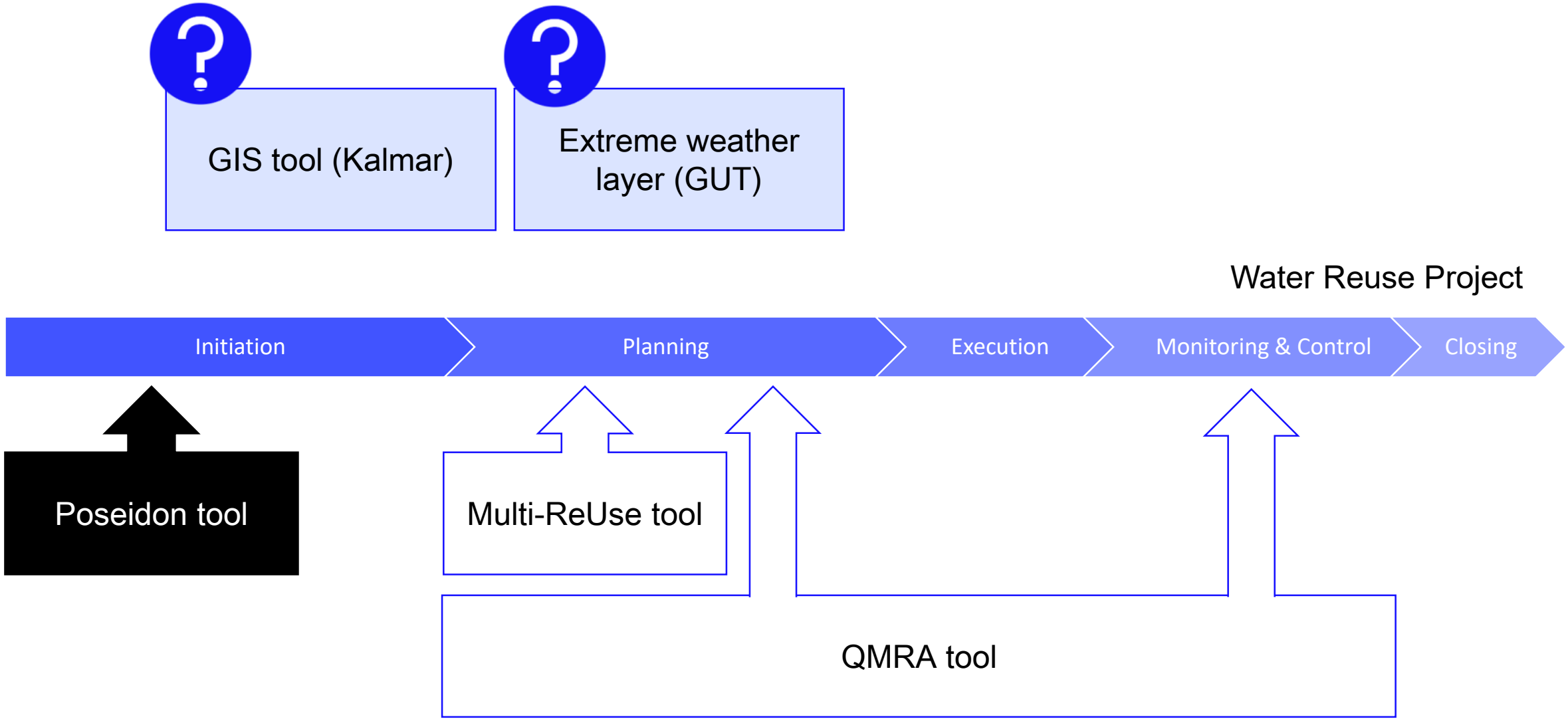
Tools for water reuse – project phase



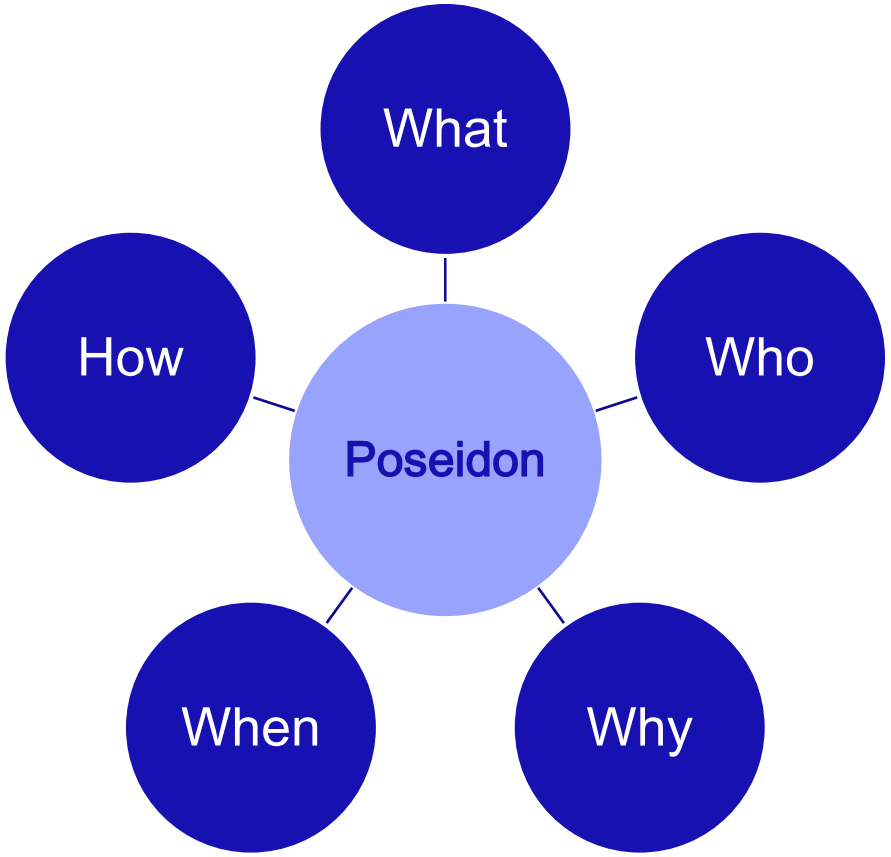
Tools for water reuse – project phase



Tools for water reuse – project phase



Poseidon – decision support tool for water reuse



MADFORWATER

European Commission

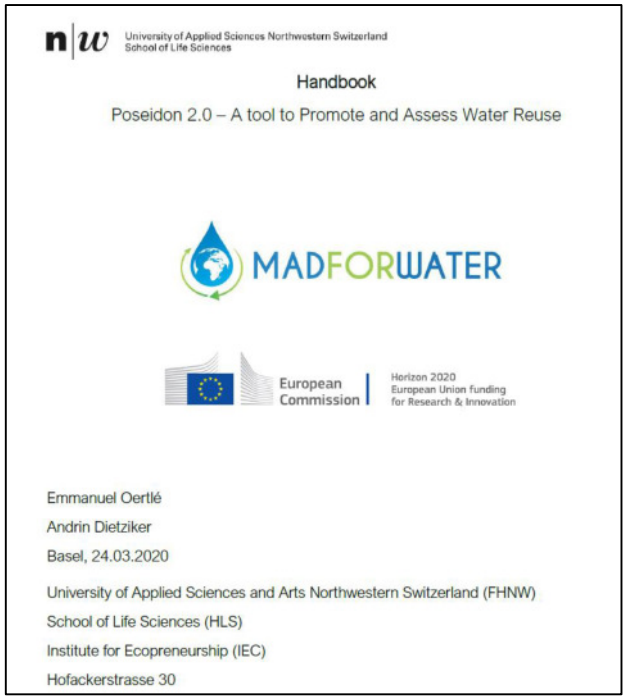
Horizon 2020
European Union funding
for Research & Innovation

Poseidon – decision support tool for water reuse

What

… is Poseidon:

- An open access decision support tool for water reuse
- developed in a EU Horizon 2020 project (MADFORWATER) by the University of Applied Sciences and Arts Northwestern Switzerland in 2019
- Promotes and assesses water reuse
- Excel sheet & Handbook



University of Applied Sciences Northwestern Switzerland
School of Life Sciences

Handbook

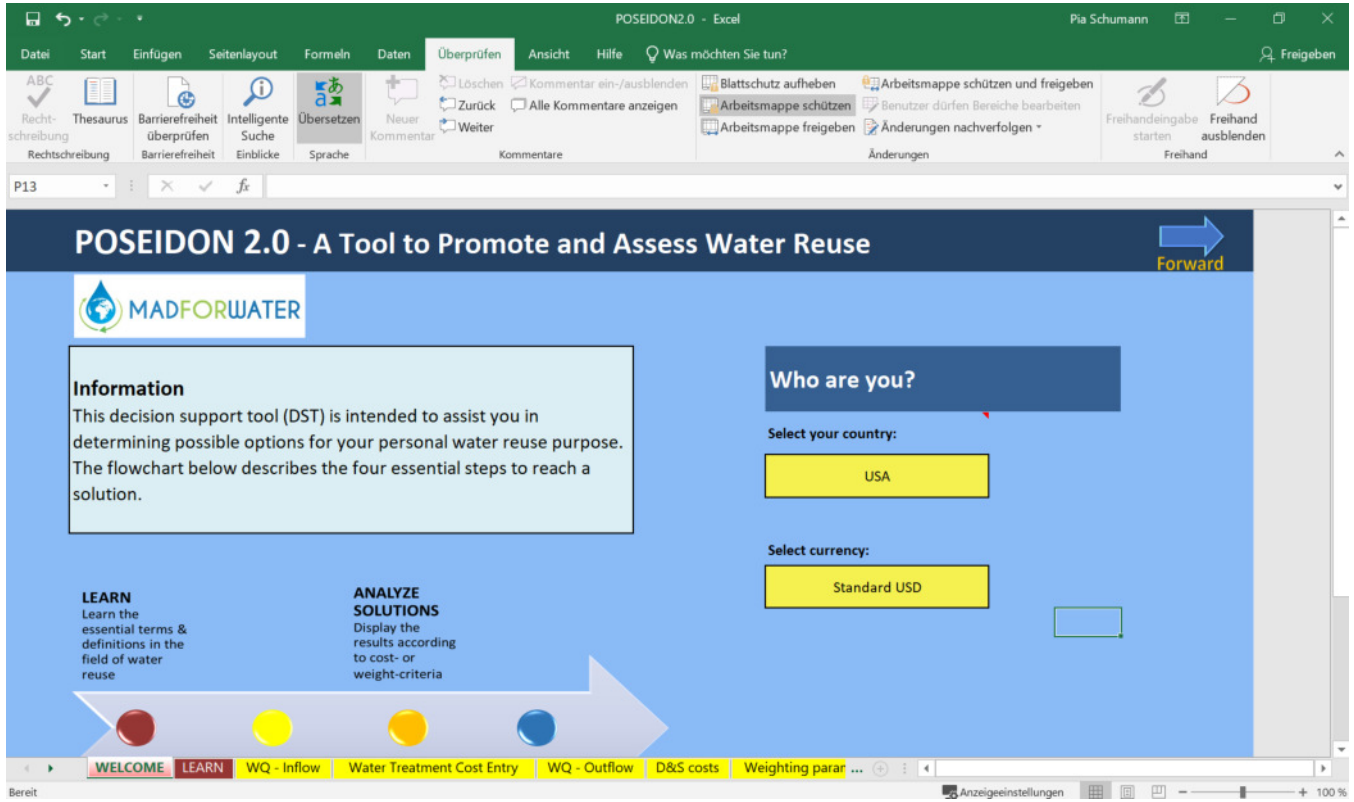
Poseidon 2.0 – A tool to Promote and Assess Water Reuse

MADFORWATER

European Commission | Horizon 2020 European Union funding for Research & Innovation

Emmanuel Oertlé
Andrin Dietziker
Basel, 24.03.2020

University of Applied Sciences and Arts Northwestern Switzerland (FHNW)
School of Life Sciences (HLS)
Institute for Ecopreneurship (IEC)
Hofackerstrasse 30



Poseidon – decision support tool for water reuse

Who

… uses Poseidon:

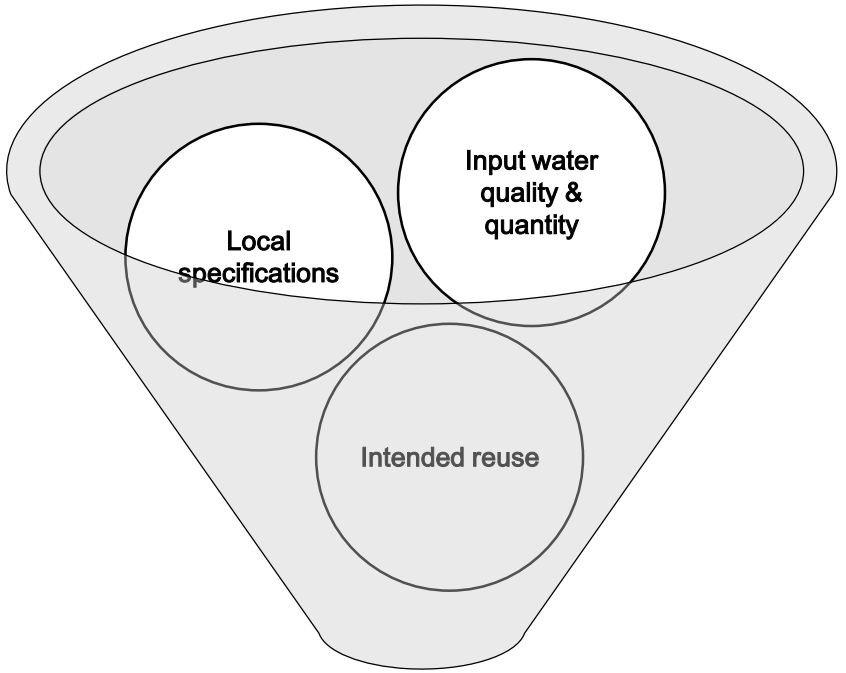
- Decision makers & stakeholders in water reuse
- Non-experts

Why

… use Poseidon:

- To learn about water reuse
- To identify & compare promising treatment options

Poseidon – decision support tool for water reuse



Why

… use Poseidon:

- To learn about water reuse
- To identify & compare promising treatment options

1. 3 best treatment options (beginner)

2. Compare pre-defined treatment options (expert)

Poseidon – decision support tool for water reuse

When

… use Poseidon:

- At early stages of a water reuse project
- Pre-feasibility stage

How

… does Poseidon work and what kind of input is needed:

Poseidon – steps

Step

Starting water quality & quantity

Final water quality requirements

Water treatment costs

Distribution & storage costs

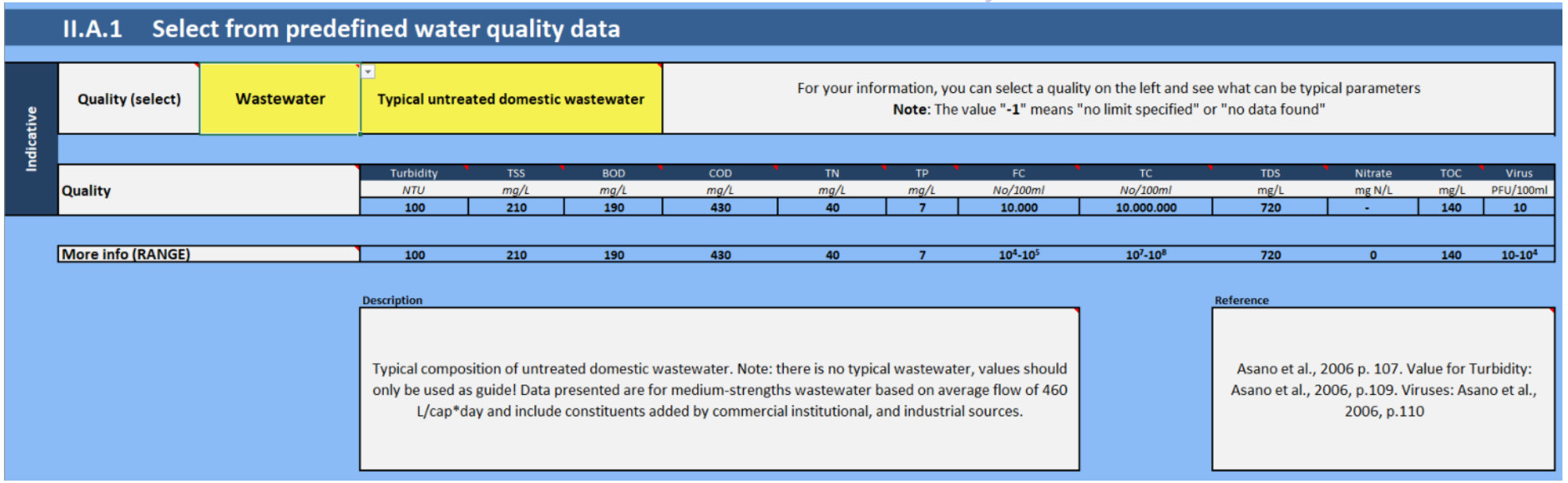
Additional criteria

Input

Estimated quantity

Estimated quality:

Choose from underlying literature data or fill in your own values



II.A.1 Select from predefined water quality data

Indicative

Quality (select)	Wastewater	Typical untreated domestic wastewater	For your information, you can select a quality on the left and see what can be typical parameters **Note:** The value "**-1**" means "no limit specified" or "no data found"

Quality	Turbidity	TSS	BOD	COD	TN	TP	FC	TC	TDS	Nitrate	TOC	Virus
	NTU	*mg/L*	*mg/L*	*mg/L*	*mg/L*	*mg/L*	*No/100ml*	*No/100ml*	mg/L	mg N/L	mg/L	PFU/100ml
	100	210	190	430	40	7	10.000	10.000.000	720	-	140	10
More info (RANGE)	100	210	190	430	40	7	10^4-10^5	10^7-10^8	720	0	140	10-10^4

Description

Typical composition of untreated domestic wastewater. Note: there is no typical wastewater, values should only be used as guide! Data presented are for medium-strengths wastewater based on average flow of 460 L/cap*day and include constituents added by commercial institutional, and industrial sources.

Reference

Asano et al., 2006 p. 107. Value for Turbidity: Asano et al., 2006, p.109. Viruses: Asano et al., 2006, p.110

Poseidon – steps

Step

Starting water quality & quantity

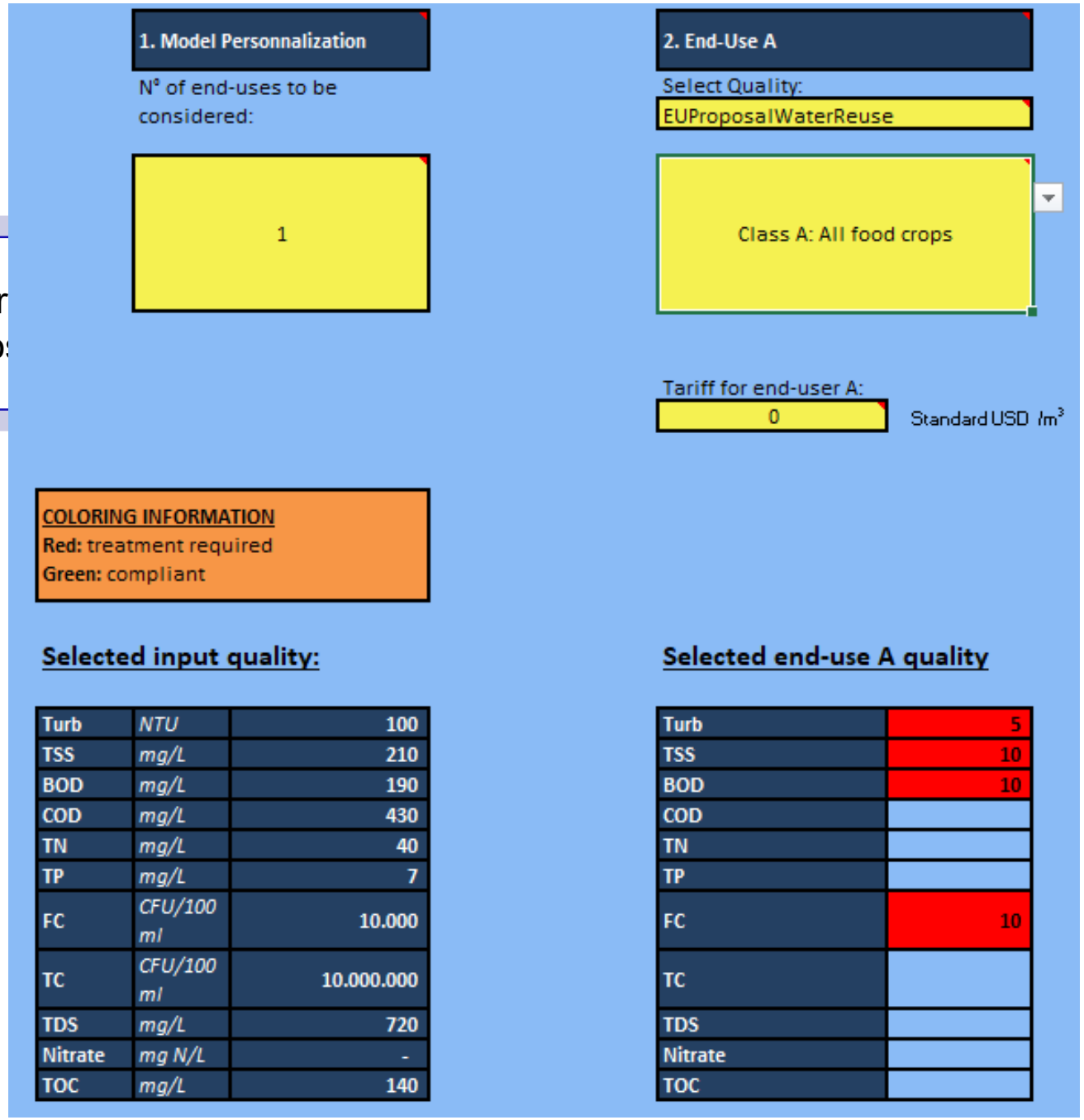
Final water quality requirements

Water tr… co…

Input

Choose from underlying requirements:

- California
- WHO
- USEPA
- etc.



1. Model Personnalization

N° of end-uses to be considered:

1

2. End-Use A

Select Quality:

EUProposalWaterReuse

Class A: All food crops

Tariff for end-user A:

0 Standard USD /m³

COLORING INFORMATION
Red: treatment required
Green: compliant

Selected input quality:

Turb	NTU	100
TSS	mg/L	210
BOD	mg/L	190
COD	mg/L	430
TN	mg/L	40
TP	mg/L	7
FC	CFU/100 ml	10.000
TC	CFU/100 ml	10.000.000
TDS	mg/L	720
Nitrate	mg N/L	-
TOC	mg/L	140

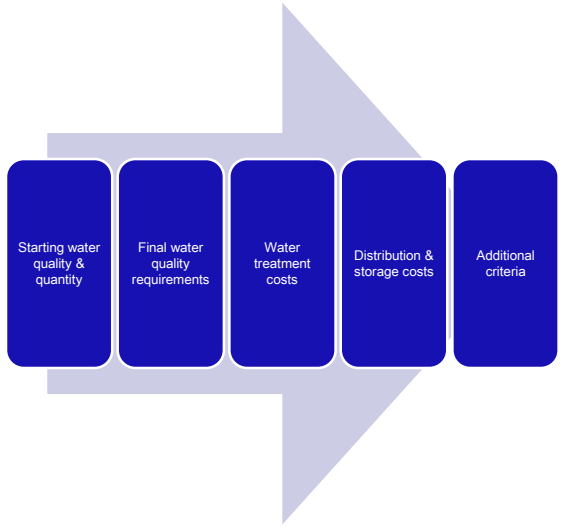
Selected end-use A quality

Turb	5
TSS	10
BOD	10
COD	
TN	
TP	
FC	10
TC	
TDS	
Nitrate	
TOC	

Poseidon – steps

Step	Starting water quality & quantity	Final water quality requirements	Water treatment costs	Distribution & storage costs	Additional criteria
Input	Estimated quantity Estimated quality: Choose from underlying literature data or fill in your own values	Choose from underlying requirements: • California • WHO • USEPA • etc.	• Land costs • Electricity costs • Personell • Interest rate and Inflation rate	• Pipe length • Area type • Elevation • Storage type	Weigh additional criteria (*not very important* to *very important*): • Technical evaluation • Requirements and impacts • Costs and resources

Poseidon – results



3 best treatment options

Costs

Further information

Option 1	Option 2	Option 3
Title 22: Belgium	Soil treatment: Israel	Only disinfection: Brazil
Score: 2,58	Score: 2,54	Score: 2,53
Rec. [%]: 99	Rec. [%]: 99	Rec. [%]: 99
Treatment costs [CUR/m3] 1,16	Treatment costs [CUR/m3] 1,36	Treatment costs [CUR/m3] 0,64
Distribution costs [CUR/m3] 0,11	Distribution costs [CUR/m3] 0,11	Distribution costs [CUR/m3] 0,11
Cost-Revenue [CUR/m3] **1,27**	**Cost-Revenue [CUR/m3]** **1,47**	**Cost-Revenue [CUR/m3]** **0,75**
Unit Processes (UP)	**Treatment Trains (TT)**	**Click here for detailed cost information**

Poseidon – results

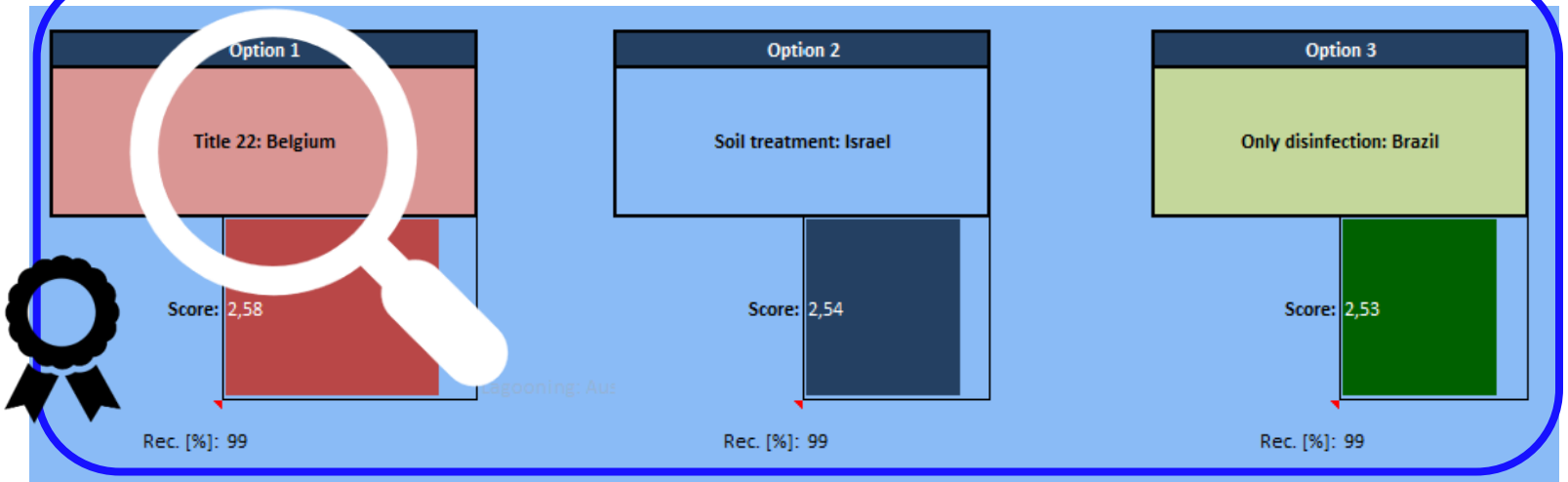
3 best treatment options

Costs

Further information

Poseidon – results

3 best treatment options



Back

Information - Selected typical treatment trains

Select the treatement train ---------->

Title 22: Belgium

Unit processes	
UP 1	Low Loaded Activated Sludge w de-N + sec. Sedim.
UP 2	Enhanced biological phosphorus removal (EBPR)
UP 3	Ozonation
UP 4	0
UP 5	0
UP 6	0
UP 7	0
UP 8	0
UP 9	0
UP 10	0

Case studies	
This treatment train has been applied in the case study described here. Follow the link to access to the project.	Example from Belgium re-using water to produce cooling water for industrial purposes (AQUAREC, 2006).

A pharmaceutical company (Tienen) makes use of treated municipal wastewater for cooling water. Secondary treated effluent is ozonated for disinfection. If the amount of reclaimed wastewater is too low or temperature too high, it is mixed with groundwater before usage. The WWTP consists of low loaded activated sludge system with enhanced biological phosphorus removal (AQUAREC, 2006).

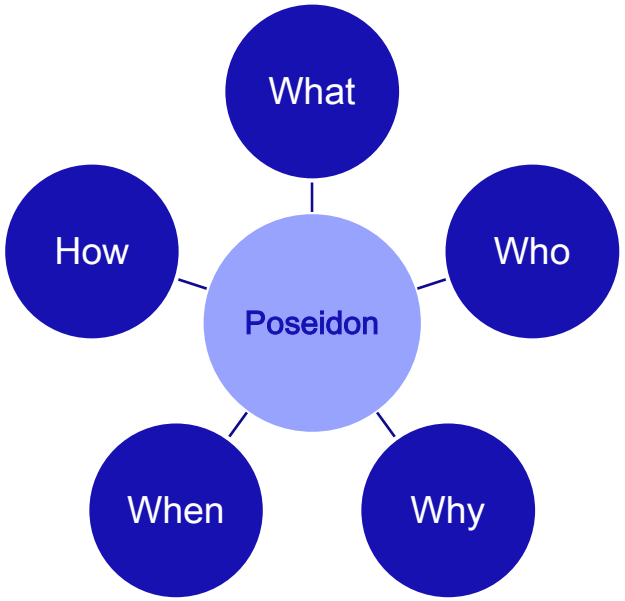
Treatment costs [CUR/m3]	1,36
Distribution costs [CUR/m3]	0,11
Cost-Revenue [CUR/m3]	**1,47**

Treatment costs [CUR/m3]	0,64
Distribution costs [CUR/m3]	0,11
Cost-Revenue [CUR/m3]	**0,75**

Treatment Trains (TT)

Click here for detailed cost information

Poseidon – limitations & advantages



- Is not a technical design tool
- Does not substitute an in-depth analysis of a specific case/ feasibility study
- Is based on literature data → gives estimations, which include uncertainties
- European countries and € not inlcuded in underlying local options
- Manual input of water quality requirements not possible
- Some important underlying data is missing; e.g. feacal coliforms for secondary effluent

- Flexible use: designed for users with limited knowledge & experts
- Requires limited input data
- Comprises capacity building components
- Does not require additional software
- Access free
- Under continuous development

Poseidon – download and literature

Where to find the tool and the handbook:

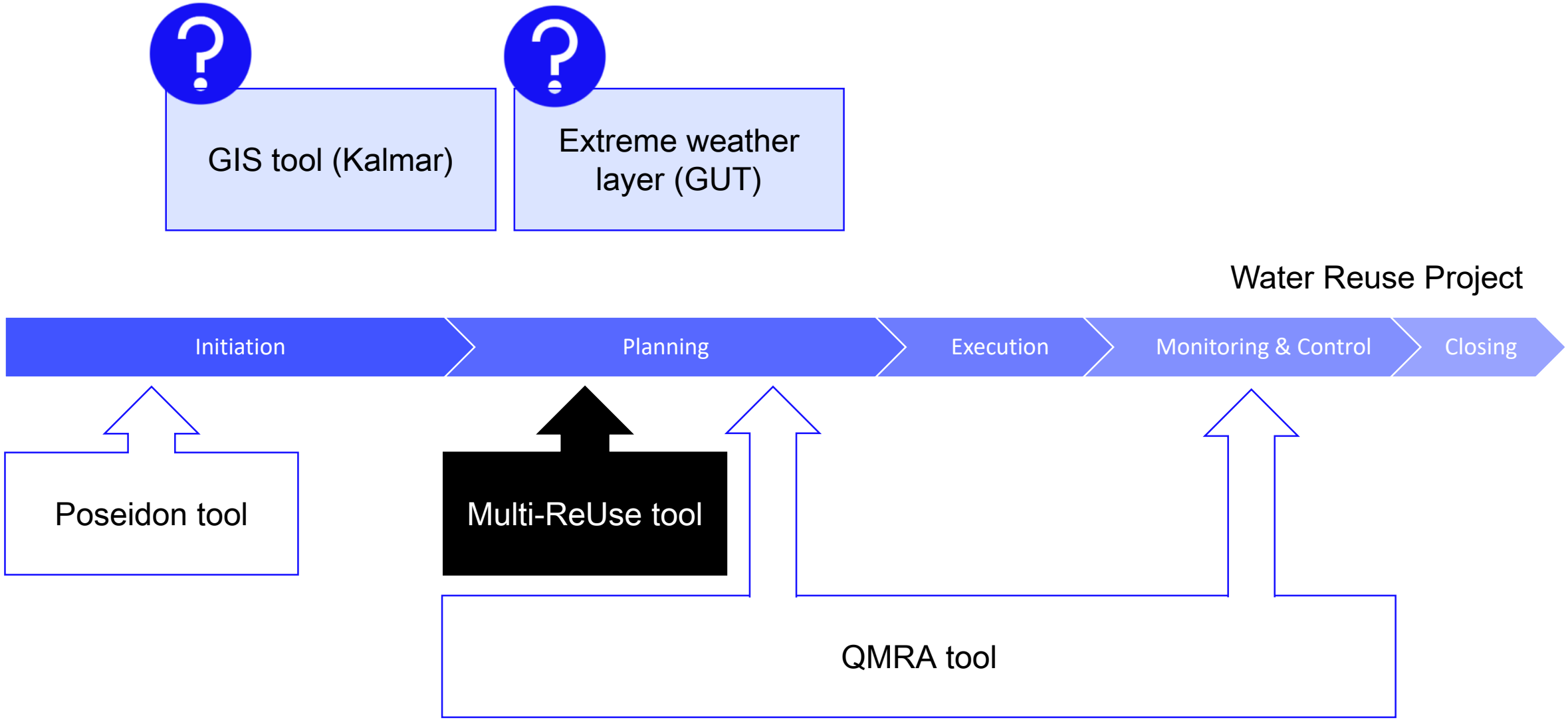
- https://zenodo.org/record/3755380#.ZFkMVc7P2Uk

Literature:

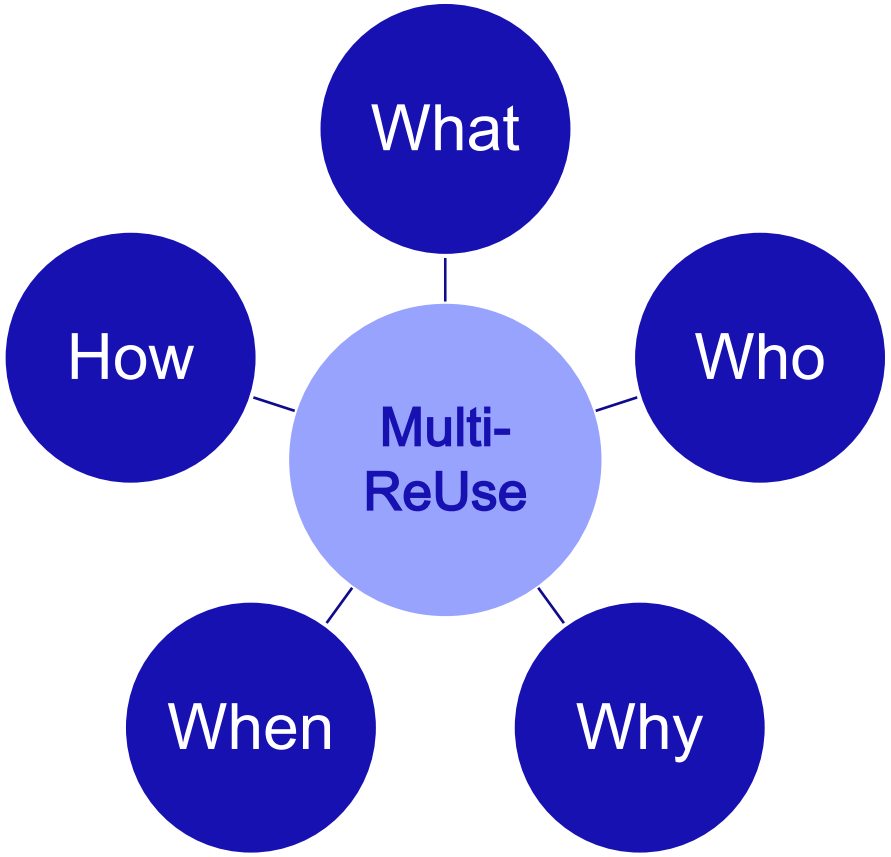
- Publication: Oertlé, E.; Hugi, C.; Wintgens, T.; Karavitis, C.A. Poseidon—Decision Support Tool for Water Reuse. Water 2019, 11, 153.

Tool update 2020 → comprises EU water reuse regulation in drop down menu for water quality requirements as „EU proposal water reuse“

Tools for water reuse – project phase



Multi-ReUse – sustainability assessment tool



Federal Ministry
of Education
and Research

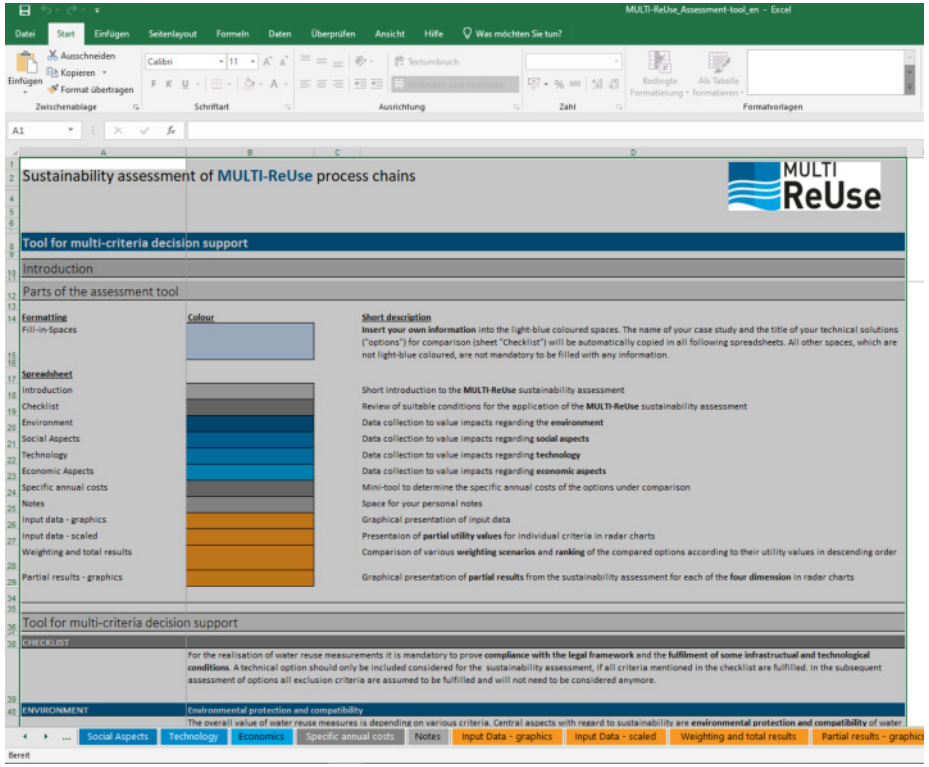
MULTI
ReUse

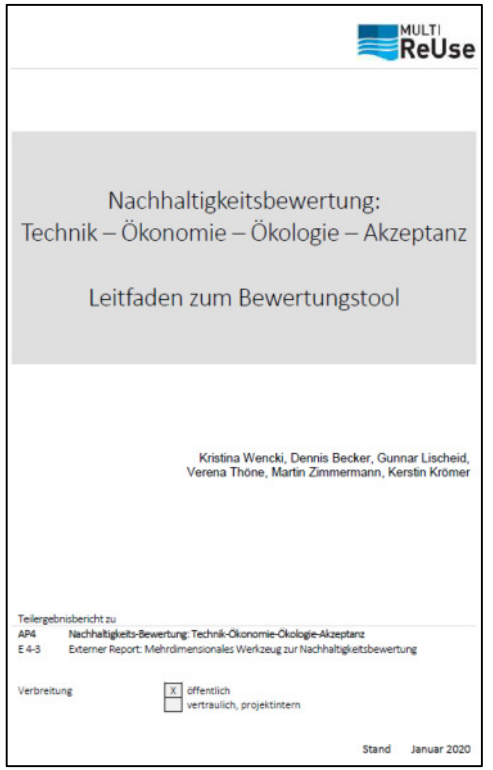
Multi-ReUse – sustainability assessment tool

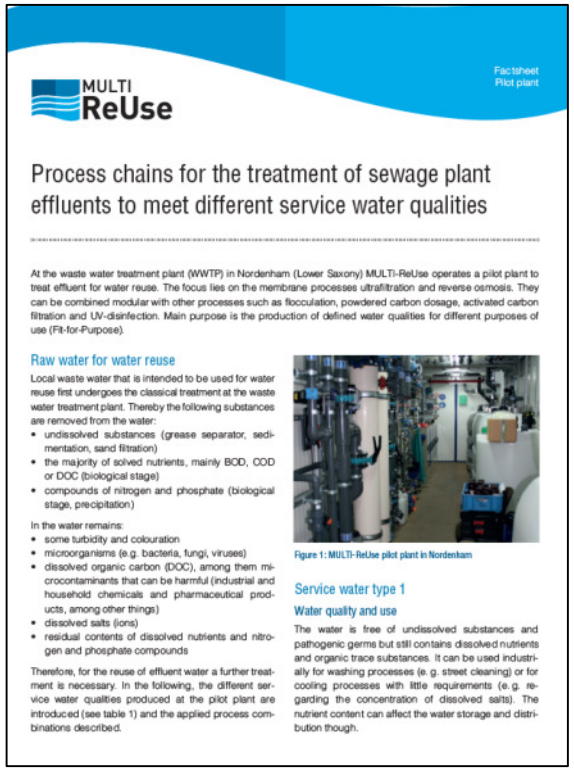
What

… is Multi-ReUse:

- An open access sustainability assessment tool for water reuse technologies
- Developed in German research project “MULTI ReUse” in 2020 by the project consortium (IWW Water Centre amongst others)
- Excel sheet (English/German), handbook (German only), additional document on treatment chains (English/German)







Multi-ReUse – sustainability assessment tool

Who

… uses Multi-ReUse:

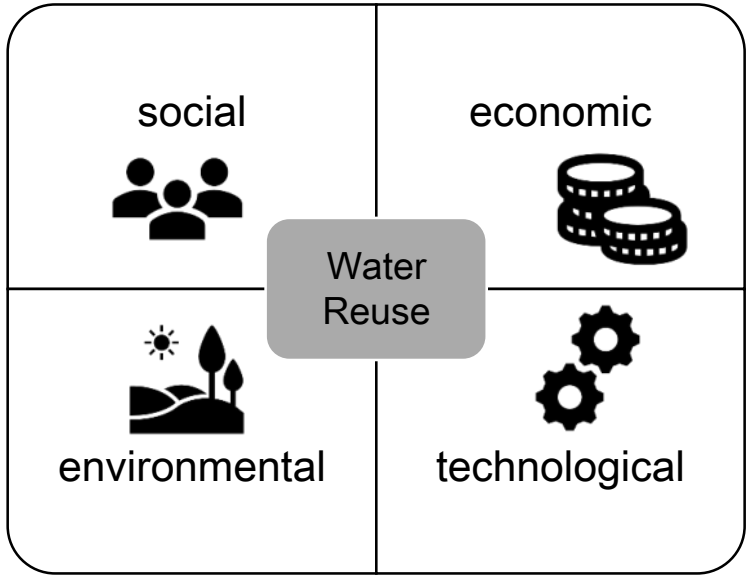
- Local actors in water companies for water supply and wastewater treatment
- Consulting engineers, plant manufacturers & operators in the water sector
- Local decision makers in municipalities & authorities
- Agriculture representatives

- Requires knowledge base on water reuse

Why

… use Multi-ReUse:

- To compare different water reuse schemes (e.g. technologies; sites) with the status quo
- Takes into account social, economic, environmental and technological aspects
- To weigh, quantify & communicate stakeholder specific requirements



Multi-ReUse – sustainability assessment tool

When

… use Multi-ReUse:

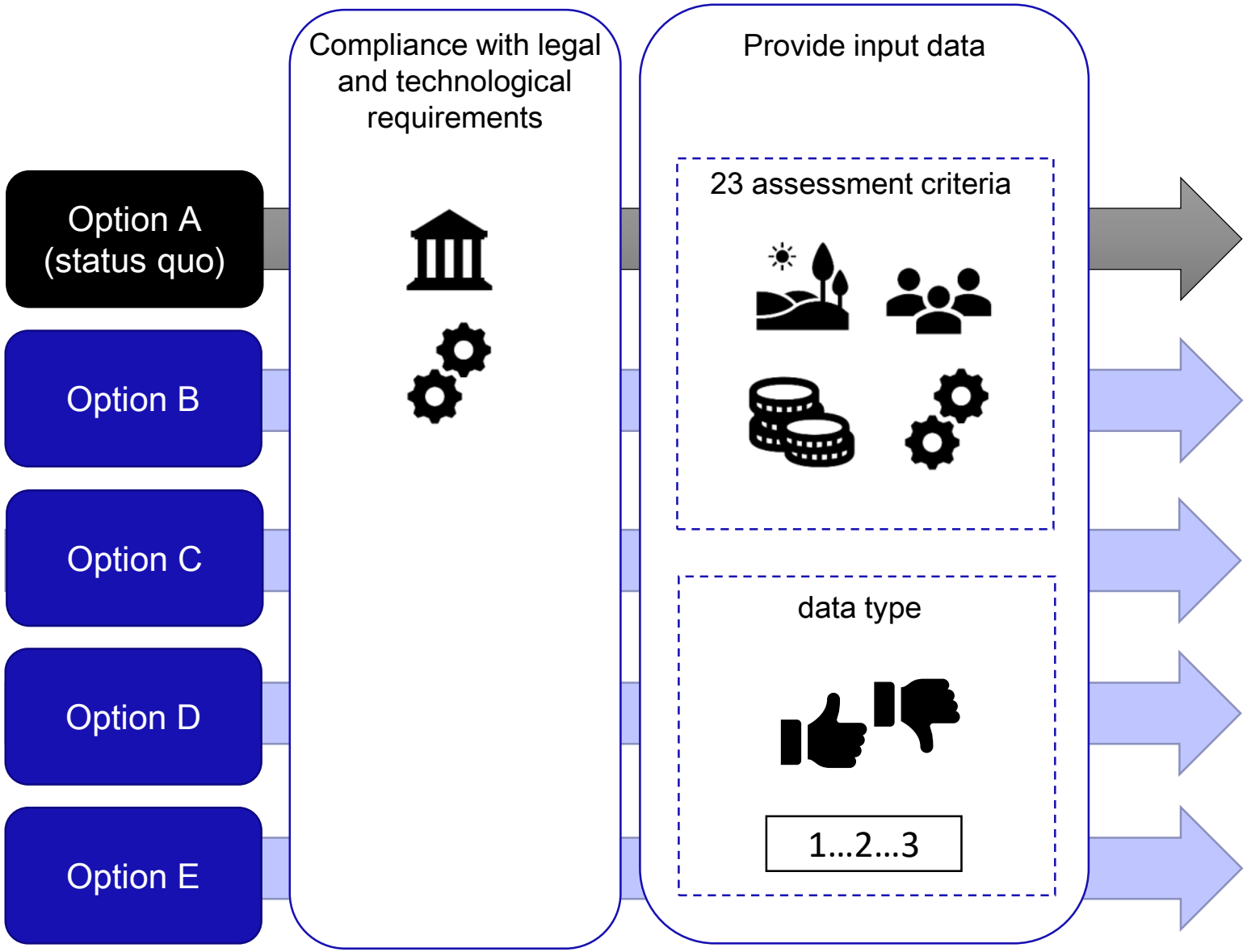
- At early stages of the planning phase of a water reuse project

How

… to use Multi-ReUse:

- Establish 2 to 5 pre-selected water reuse alternatives to compare (one is the status quo)

Multi-ReUse – steps



Multi-ReUse – steps

Option A (status quo)

Option B

Option C

Option D

Option E

Compliance with legal and technological requirements

Provide input data

23 assessment criteria

No.	Criteria	Indicators	Unit	Option I *title option I*	Option II *title option II*	Option III *title option III*
U01	**Space requirements**	**Overall space requirements for** the treatment facility • Space requirements include the area of the treatment facility itself and all areas required for the water supply infrastructure (e.g. pipe network). • The smaller the space required, the lower the ecological footprint of a treatment facility. • All areas becoming unusable through the facility need to be considered, too.	m^2/m^3	18	374	200
U02	**Energy consumption**	**Specific net energy consumption per m^3** water produced • Energy is needed in numerous process steps in water treatment, e. g. pumping, metering and several other processes. • The specific energy demand includes among other things: the energy requirement for water treatment and distribution (incl. measurement and control technology, illumination and ventilation of the buildings), etc.	kWh/m^3	0,520	0,690	1,340

Environment | Social Aspects | Technology | Economics | Specific annual costs | Notes | Input Data - graphics | Input Data - scaled | Weighting and total results | Partial r...

Multi-ReUse – steps

Compliance with legal

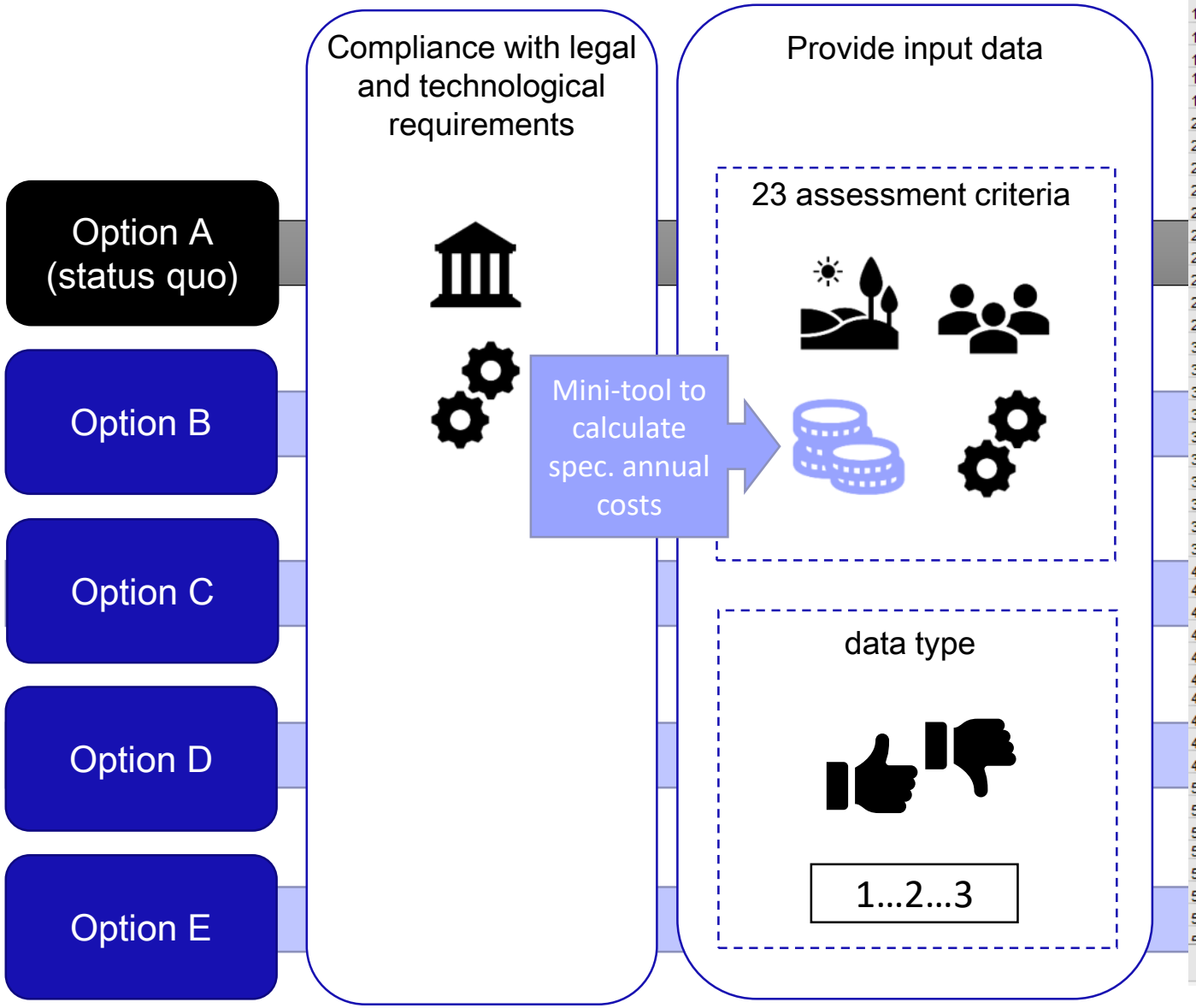
Provide input data

- Option A (status quo)
- Option B
- Option C
- Option D
- Option E

No.	Criteria	Indicators	Unit	Option I *title option I*	Option II *title option II*	Option III *title option III*
S04	Acceptance	**Acceptance of water reuse** itself as well as of the **products produced with reuse water** • Depending on the intended use is it possible that water reuse or products made of reused water are declined by the consumers, which could also result in an negative attitude towards the operator of the facility. • Especially for agricultural products consumer´s acceptance of water reuse is very important to ensure that products will be sold.	-	very good	no acceptance	partly
S05	Health protection	**Health protection of** consumers in contact with pathogenetic microorganisms from reuse water • Sanitary risks can apply to persons, which are in direct or indirect contact with reuse water, e.g. agricultural employees, in contact with reuse water used for irrigation or consumers of agricultural goods. • Reference values for the evaluation of sanitary risks should be based on standard indicators such as *Escherichia coli* (*E. coli*) and Intestinal enterococci (*Int. Ent.*). • The lower the multiplication potential of	-	good	very good	adequate

... Environment | Social Aspects | Technology | Economics | Specific annual costs | Notes | Input Data - graphics | Input Data - scaled

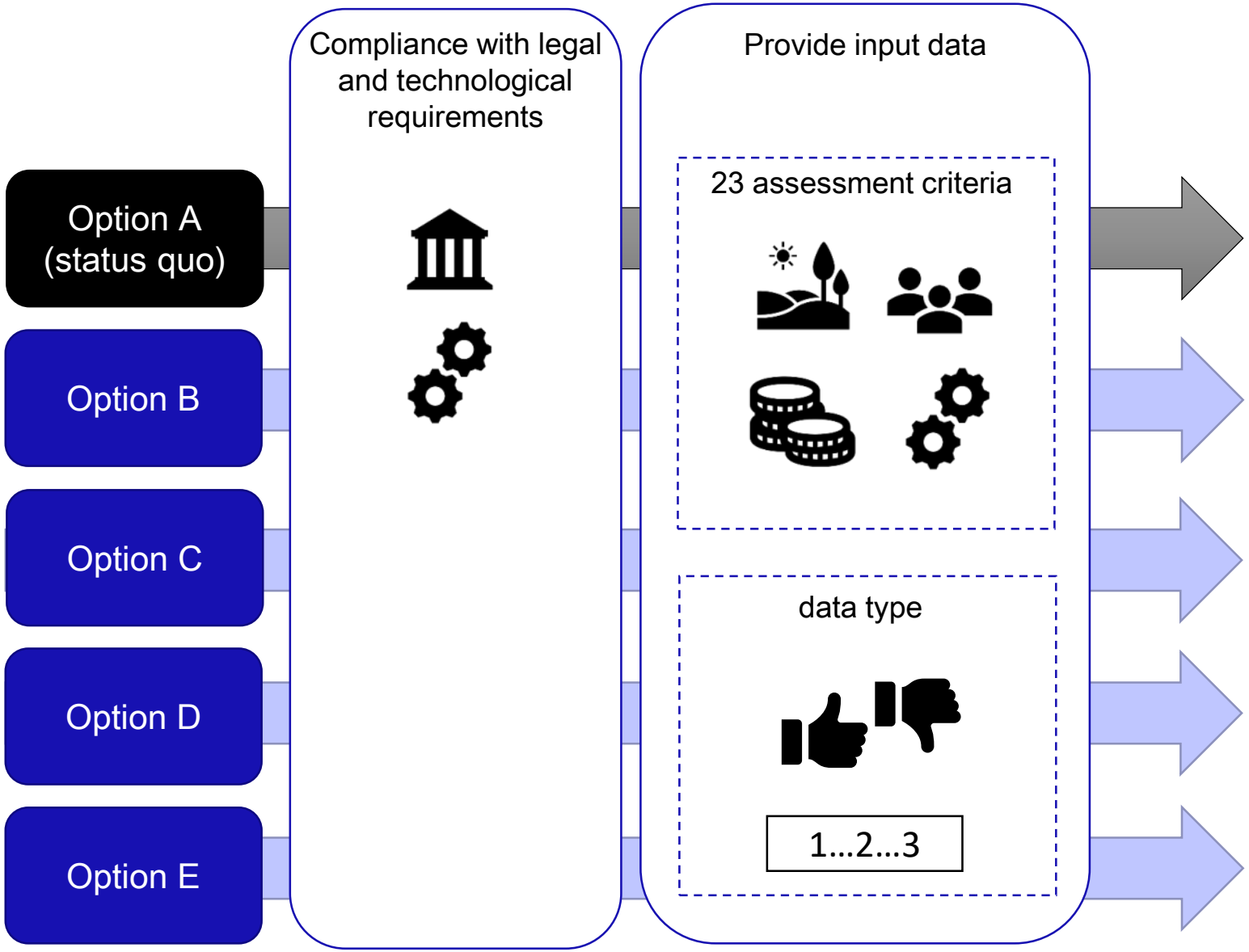
Multi-ReUse – steps



	Performance and cost data	Unit	Option I *title option I*
General information			
	Amount of treated water	m³/a	8,00
Assets			
	Property	**EUR**	**6,00 €**
	Land	EUR	3,00 €
	Buildings	EUR	2,00 €
	Structural changes	EUR	1,00 €
	Technical devices and machinery	**EUR**	**90,00 €**
	Membrane module(s)	EUR	2,00 €
	Racks	EUR	4,00 €
	Pipelines	EUR	6,00 €
	Fittings	EUR	8,00 €
	Pumps	EUR	10,00 €
	Dosing systems	EUR	12,00 €
	Measuring instruments	EUR	14,00 €
	Electric devices	EUR	16,00 €
	Other devices	EUR	18,00 €
	Plant and business equipment	**EUR**	**30,00 €**
	Tools	EUR	3,00 €
	Hardware	EUR	6,00 €
	Software licences	EUR	9,00 €
	Other equipment	EUR	12,00 €
	Immaterial and financial assets	**EUR**	**8,00 €**
	Other assets	**EUR**	**9,00 €**
Staff			
	Wages and salaries	**EUR/a**	**1,00 €**
	Training expenses (internal)	**EUR/a**	**2,00 €**
	Other costs	**EUR/a**	**3,00 €**
Material			
	Energy	**EUR/a**	**1,00 €**
	Resources	**EUR/a**	**2,00 €**
	Operating supplies	**EUR/a**	**3,00 €**
	Wastes	**EUR/a**	**4,00 €**
	Other material	**EUR/a**	**5,00 €**
Services			
	Expertises, consultation	**EUR/a**	**1,00 €**
	Training expenses (external)	**EUR/a**	**2,00 €**
	Other services	**EUR/a**	**3,00 €**

... Environment | Social Aspects | Technology | Economics | Specific annual costs

Multi-ReUse – steps



Results

Focus					Individual
A	4	4	4	5	4
B	3	1	2	3	2
C	2	3	1	2	3
D	1	2	3	1	1
E	5	5	5	4	5

Multi-ReUse – graphical input & output

Option A (status quo)

Option B

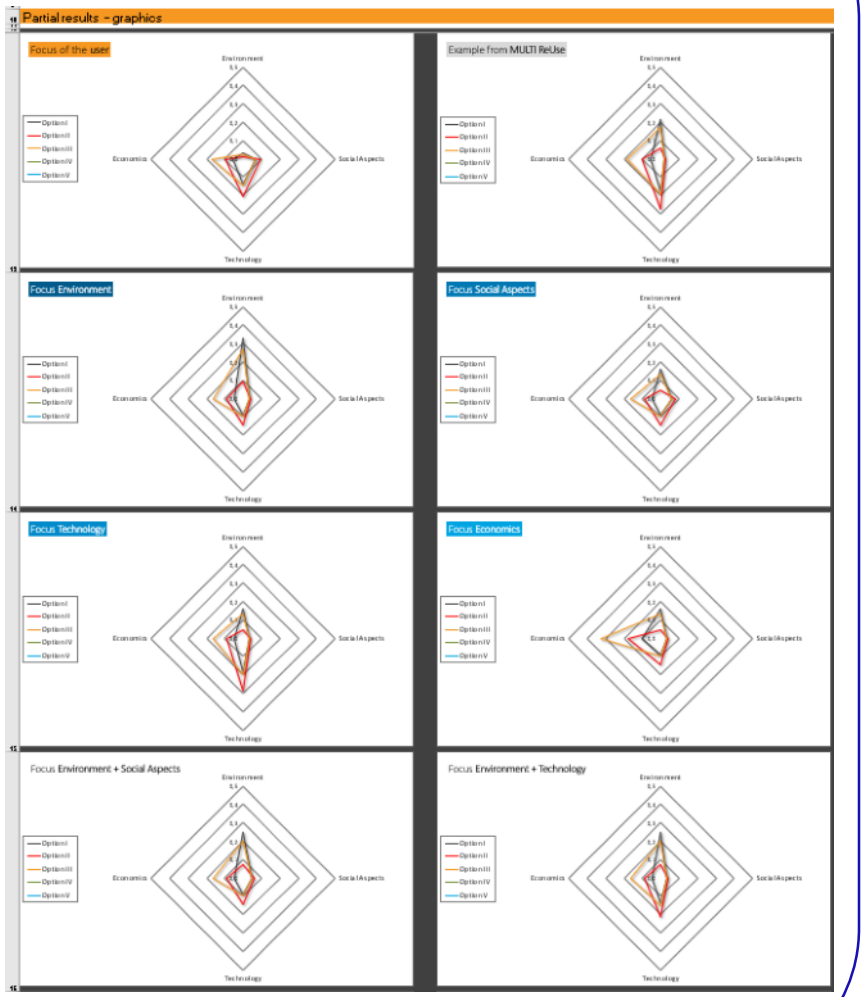
Option C

Option D

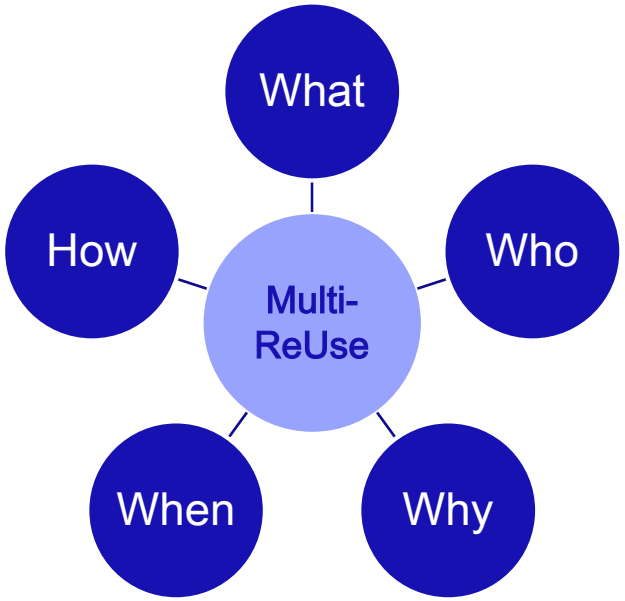
Option E

Overview input

Overview results



Multi-ReUse – limitations & advantages



- Handbook only available in German
- Knowledge on water reuse in general & specific options needed
- Does not substitute a comprehensive life cycle assessment analysis

- Includes economic, social, technological & environmental aspects in the assessment
- Different perspectives (end user…) are included
- Choice between quantitative & qualitative data entry
- User-friendly graphical visualisation of input & results
- Open access

Multi-ReUse – websites & download

- Websites & Download:

Tool (Ge/En):

https://water-multi-reuse.org/en/when-does-water-reuse-make-economic-ecological-and-technical-sense/

Handbook (German only):

https://iww-online.de/bmbf-vorhaben-multi-reuse-entwickelt-ein-tool-zur-nachhaltigkeitsbewertung/

KWB

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